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**Name of Organization:** Michigan State University - Institute of Water Research

**Type of Organization:** College or University

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**Project Title:** Managing Atrazine Loadings to the St. Joseph River

**Project Category:** Pollution Prevention and Reduction - BNS

**Rank by Organization (if applicable):** 0

**Total Funding Requested (\$):** 114,840 **Project Duration:** 2 Years

**Abstract:**

The St. Joseph River contributes the largest load of atrazine to Lake Michigan. Approximately 90 percent of the flow in the St. Joseph River is ground-water discharge, as opposed to direct surface runoff. Management practices that target reduction of atrazine via direct surface runoff may be relatively ineffective in the St. Joseph River watershed. Additionally, load reduction goals with milestones of 5 to 10 years may not be achievable due to travel times of contaminants in ground water that exceed 10 years. Realistic and effective reduction of agricultural chemical loadings to the St. Joseph River requires an understanding of the hydrological processes and land uses in the watershed. In particular, the following three questions need to be answered. (1) Is most atrazine delivered to the river via ground water or surface runoff? (2) What areas of the watershed produce the highest loads? (3) If most of the atrazine loading is from ground water, then what are the travel times of contaminated ground water from application areas to streams? Furthermore, in addressing these three questions, a fourth should be considered. What are loadings of other agricultural chemicals relevant to the Lake Michigan LaMP? This project will address the first two questions using simple, cost-effective approaches that make use of ongoing data-collection efforts in the St. Joseph River watershed and the formation of partnerships among the Institute for Water Research at Michigan State University, U.S. Geological Survey, Michigan Department of Environmental Quality, Michigan Department of Natural Resources, Friends of the St. Joseph River Association, agencies in Indiana, and the Great Lakes Commission. The project results will provide guidance to regulatory and management agencies that will enable establishment of informed herbicide management practices and realistic load-reduction goals. By doing so, this project will support the ecosystem objectives of the Lake Michigan LaMP.

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**Geographic Areas Affected by the Project**

**States:**

<input type="checkbox"/> Illinois	<input type="checkbox"/> New York
<input checked="" type="checkbox"/> Indiana	<input type="checkbox"/> Pennsylvania
<input checked="" type="checkbox"/> Michigan	<input type="checkbox"/> Wisconsin
<input type="checkbox"/> Minnesota	<input type="checkbox"/> Ohio

**Lakes:**

<input type="checkbox"/> Superior	<input type="checkbox"/> Erie
<input type="checkbox"/> Huron	<input type="checkbox"/> Ontario
<input checked="" type="checkbox"/> Michigan	<input type="checkbox"/> All Lakes

**Geographic Initiatives:**

<input type="checkbox"/> Greater Chicago	<input type="checkbox"/> NE Ohio	<input type="checkbox"/> NW Indiana	<input type="checkbox"/> SE Michigan	<input type="checkbox"/> Lake St. Clair
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**Primary Affected Area of Concern:** Not Applicable

**Other Affected Areas of Concern:**

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***For Habitat Projects Only:***

**Primary Affected Biodiversity Investment Area:**

**Other Affected Biodiversity Investment Areas:**

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**Problem Statement:**

According to the February 2000 draft LaMP document and the LMMB study, the St. Joseph River contributes the largest load of atrazine to Lake Michigan. Per square mile of drainage area, it is also the largest contributor. As is characteristic of most Michigan streams, nearly all of the flow of the St. Joseph River comes from ground-water discharge, as opposed to direct surface runoff (water reaching a stream by overland flow). About 90 percent of the flow in the St. Joseph River is derived from ground water, based on the analysis of long-term flow records at 17 USGS gages (Holtschlag and Nicholas, 1998). Therefore, it is reasonable to assume that most of the atrazine in the St. Joseph River comes from ground-water.

Management practices that target surface runoff to reduce atrazine loads may not be effective in the St. Joseph River watershed. These practices typically increase ground-water loads while reducing loads from surface runoff. Additionally, load reduction goals with milestones of 5 to 10 years may not be achievable due to travel times of contaminants in ground water that exceed 10 years. Research in New Jersey and Delaware has demonstrated that agricultural pollutants, such as atrazine and nitrate, in shallow aquifers can take from several decades to more than a century to flow from application areas to streams and lakes (Modica, 1999; Shedlock and others, 1999).

Realistic and effective reduction of agricultural chemical loadings to the St. Joseph River requires an understanding of the hydrological processes and land uses in the watershed. In particular, the following three questions need to be answered. (1) Is most atrazine delivered to the river via ground water or surface runoff? (2) What areas of the watershed produce the highest loads? (3) If most of the atrazine loading is from ground water, then what are the travel times of contaminated ground water from application areas to streams? Furthermore, in addressing these three questions, a fourth should be considered. What are the other major agricultural chemicals--including pesticide breakdown products and chemicals from animal feeding operations--being delivered to the river, and what are their concentrations and loads. This proposal addresses the first two questions, and we expect the others to be addressed by complementary efforts.

The Lake Michigan LaMP report identifies tributary loadings as the primary pathway for atrazine to reach the Lake. Although atmospheric pathways are important, these loadings are smaller and geographically dispersed. Tributary loadings may result in local Lake Michigan concentrations posing ecological threats or impairing public drinking-water supplies. While the St. Joseph River is not an AOC and atrazine is categorized as an emerging contaminant, addressing the atrazine loadings issue in southern Lake Michigan is consistent with the LaMP vision of addressing ecosystem objectives and the chemical stressors that need to be reduced in order to meet those objectives.

**Proposed Work Outcome:**

The proposed work is designed to address the first two questions in the problem statement and provide information for

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complementary or follow-up studies that will answer the other two questions. The approach has the following major components; lead agencies are identified for each:

- (1) Calculation of the ground-water component of total streamflow at about 20 USGS gages in the St. Joseph River watershed using the streamflow partitioning program of Rutledge (1993) or other applicable partitioning techniques. USGS lead.
- (2) Characterization of agricultural land use within subwatersheds associated with each streamgage and how these land uses have changed since the 1970s using remote imagery and GIS. IWR lead.
- (3) Estimated use of atrazine within subwatersheds associated with each streamgage and how these uses have changed since the 1970s using sales/application records, crop-type imagery, and GIS. IWR lead.
- (4) Derivation of a watershed map showing the darcy flux of ground water and identification of stream reaches with highest ground water fluxes using the research model of Wiley and Seelbach (2000). DNR Institute of Fisheries Research lead.
- (5) Operation of streamgages and sampling of stream water to determine the annual loads of atrazine at select gages. Immuno-assay techniques will be used for all samples. After screening with immuno-assay, a subset of the samples will be analyzed at the National Water Quality Laboratory for atrazine, metabolites, and potentially other chemicals relevant to the LaMP. USGS lead with DEQ and local or volunteer assistance.
- (6) Bi-monthly sampling of ground water from temporary piezometers in the near-stream environment to determine atrazine concentrations in areas of high ground-water discharge. USGS lead with local or volunteer assistance.
- (7) Interpretation of results including determination of the loading of atrazine from ground water versus surface runoff and the reaches of stream with the highest ground-water loadings. Collaborative effort.
- (8) Communication of findings via a formal report, the Internet, and stakeholder meeting(s) in the watershed.

The results of this study will provide the public, the agricultural community, and relevant management and regulatory agencies with a sound scientific basis for atrazine load-reduction targets and implementation of management practices on agricultural land. It will also assist modelers on the LMMB study with information on expected long-term loadings of atrazine to Lake Michigan.

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**Project Milestones:****Dates:**

Project Start	10/2000
Partition streamflow	11/2000
Land-use and flux characterization	03/2001
Begin sampling	04/2001
End sampling	03/2002
Complete interpretation	07/2002
Communicate results	09/2002
Project End	09/2002

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☐ Project Addresses Environmental Justice

**If So, Description of How:**

☒ Project Addresses Education/Outreach

**If So, Description of How:**

Project partners will collaborate with the Great Lakes Commission on bi-state outreach and workshop efforts in the St. Joseph River watershed. These efforts will be designed to bring the public, organizations, and agencies to a common understanding of herbicide loading issues and implications for management and ecosystem health.

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**Project Budget:**

	<b>Federal Share Requested (\$)</b>	<b>Applicant's Share (\$)</b>
<b>Personnel:</b>	20,000	5,000
<b>Fringe:</b>	6,400	1,600
<b>Travel:</b>	3,000	0
<b>Equipment:</b>	0	0
<b>Supplies:</b>	1,000	0
<b>Contracts:</b>	70,000	0
<b>Construction:</b>	0	0
<b>Other:</b>	0	0
<b>Total Direct Costs:</b>	100,400	6,600
<b>Indirect Costs:</b>	14,440	3,135
<b>Total:</b>	114,840	9,735
<b>Projected Income:</b>	0	0

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**Funding by Other Organizations (Names, Amounts, Description of Commitments):**

The contracts above will go to two agencies which will provide funding:

-\$20,000 over 2 years to the MDNR Institute for Fisheries Research; the IFR will provide in-kind services of \$20,000 devoted to application of their ground-water loadings research model.

-\$50,000 over 2 years to the USGS; the USGS will provide matching funds up to \$50,000 to support analysis of the ground-water component of streamflow, sampling and analysis for atrazine, determination of atrazine loadings from ground water, and production of the final report.

MDEQ will provide in-kind support via Clean Michigan Initiative monitoring each year at a level of about \$20,000.

USGS will provide in-kind support via the Lake Michigan NAWQA and/or the new USGS Great Lakes Initiative in an amount yet to be determined.

USGS will provide in-kind support via the operation of its cooperative streamgage network and the calculation of annual discharge at about 20 gages in the amount of about \$200,000 per year.

The Great Lakes Commission will provide in-kind support through a St. Joseph Basin workshop proposed to the Michigan Great Lakes Protection Fund in the amount of \$47,600.

The Institute of Water Research is submitting a proposal to the Water Resources Research National Competitive Grants Program in the amount of \$200,000 over a 2-year period for a watershed-based NPS loading assessment in the St. Joseph Watershed.

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**Description of Collaboration/Community Based Support:**

As described above, the USGS, MDEQ, MDNR, and GLC have ongoing or proposed work in the St. Joseph Basin that will significantly leverage this GLNPO project. The primary contacts at these agencies have discussed this GLNPO proposal and will support collaboration (Jim Nicholas, USGS; Rick Hobrle, MDEQ; Paul Seelbach, MDNR; and Tom Crane, GLC).

The Institute for Water Research has a distinguished history of bringing together scientific research and the agricultural community and has been heavily vested in the St. Joseph Basin for many years. The Institute's efforts have been strongly supported by the Friends of the St. Joseph River Association. Given their proven strengths in working in multi-state roles, the Institute, USGS, and GLC expect to gather additional support and collaboration from both Indiana and Michigan.